

## The Extirpation of a Population of the Endangered Illinois Cave Amphipod (*Gammarus acherondytes*) by an Exotic Species: The Wednesday Cave Debacle

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The Illinois Cave Amphipod (ICA or *Gammarus acherondytes*) is an obligate inhabitant of cave streams of southwestern Illinois. This crustacean was listed as a federal Endangered Species in 1998 due to the encroachment of civilization into its habitat—cave streams with gravel substrates. In 1998, the range of the species encompassed four cave systems in Monroe County and one in St. Clair County, although the population in the latter had been extirpated by septic pollution of the groundwater. After listing, The Nature Conservancy commissioned a project to identify new populations of the endangered species. This project resulted in the discovery of several additional cave populations distributed through four groundwater basins where the species was not previously known (Lewis, et. al 2003).

The United States Fish and Wildlife Service (USFWS) recovery plan for this endangered species required periodic population monitoring. We conducted the population monitoring that was done about every 3 years in one or more caves within all of the known groundwater basins where the ICA still occurred. Locations with larger populations took precedence over those with smaller, less important populations.

One of the new sites for the ICA was Wednesday Cave, a 30 foot long cave in the Annbriar Spring Groundwater Basin. Despite a diverse aquatic community including *G. acherondytes*, monitoring of Wednesday Cave was eclipsed by the much larger popu-

lation in Reverse Spring Cave, also in the Annbriar basin. Wednesday Cave was thought to be a fairly protected population, since the cave was a small “side passage” of the Annbriar Groundwater Basin, less susceptible to pollution than the groundwater trunk stream. Wednesday Cave’s population was monitored as a second tier site, due to its potentially protected habitat and smaller population.

The first sign of problems at Wednesday Cave occurred during a visit on 6 July 2001. As we walked down the steep sinkhole slope to the entrance, we smelled a strong phenolic odor, characteristic of the polydesmid Greenhouse Millipede, *Oxidus gracilis*. This species was thought to have originated in Japan (Hoffman, 1999), but now occurs in North America and is rapidly becoming a noxious exotic species in caves. Once we crawled through the body-sided hole and slid down the breakdown slope to a walking height passage, we encountered the small stream with a gravel substrate flowing across the cave floor. Twenty feet into the cave, the stream fell from a rimstone dam three feet high, beyond which was a broad pool spanning the passage to the cave’s end. On that day it was impossible to avoid crawling over dozens of the millipedes, many of them in copulating pairs. The millipede swarm covered the floor; every surface of the riparian zone and every piece of gravel above water. We crushed hundreds of them while progressing through the cave, resulting in a smell so great that we wondered if it might be toxic to the ICA.

As incredible as this may sound, polydesmid millipedes are known to swarm in numbers so great that they stop trains (Marek and Sierwald, 2014). Every year we receive inquiries from cavers who have sighted one of these swarms of chestnut colored, inch long Greenhouse Millipedes covering the floor and walls of some cave. The odor arises from a chemical compound secreted from dorsal glands on the millipedes, contains phenol (which is toxic as well as soluble in water), hydrogen cyanide and benzaldehyde (Habermehl, 2012).

On the next trip, in October 2007, we found a healthy population of the ICA with nine of the amphipods in a transect of 10 linear feet in length (table 1). We also discovered that the farm on which the cave was located was for sale and informed Diane Tecic, the Regional Heritage Biologist for the Illinois Department of Natural Resources (IDNR). Based on the importance of the endangered species population in Wednesday Cave, the large tract containing Wednesday Cave was purchased by The Nature Conservancy and subsequently transferred to IDNR as a state nature preserve. The habitat of the ICA seemed secure.

Concerns about the toxicity of the millipede swarms in Wednesday Cave were overshadowed by more pressing concerns during our population census visit in 2011: the entrance had disappeared under mud washing down the sinkhole wall. Using a GPS location and our recollection of the site, we identified the entrance and dug it open. Sliding down the muddy slope, we saw that most of the gravel in

the stream had disappeared under the mud. Only one ICA was found in the census. The community diversity had fallen from seven species in 2007 to four in 2011. State and federal officials were notified of the problem and the need for immediate action. Safe from groundwater pollution, and seemingly unharmed by the exotic millipedes, the ICA was under attack from an exotic species outside of the cave.

The culprit? Bush Honeysuckle. Of the 14 species of honeysuckle in Illinois, 13 are exotic species not native to the state (all in the genus *Lonicera*). Four of the exotics are bush honeysuckles and have in common a height of 15-20 feet, paired flowers and fruit, hollow stems and long, dark green lance-shaped leaves (Haupt, 2015). These honeysuckles out-compete native plants and create mono-culture hedges in forests. Allelopathy, i.e., the production of chemicals toxic to other plants, has been demonstrated in *L. maackii* (the dominant species in the area around Wednesday Cave) and is suspected in others (Gould and Gorchoff, 2000).

Three years passed. Entering the sinkhole on 9 August 2014 we fought our way through a tangled understory of Bush Honeysuckle, with few other plants on the bare soil of the forest floor. We came prepared for the worst and carried a shovel with us. It proved necessary as the entrance was buried even deeper than before under mud slumping, a result of the Bush Honeysuckle

Table 1. Population censuses of a 10 foot (3 meter) transect in Wednesday Cave, Monroe County, Illinois between 2007 and 2014 (Lewis and Lewis, 2014).

	<i>Gammarus acherondytes</i>	<i>Gammarus troglophilus</i>	<i>Caecidotea brevicauda</i>	<i>Caecidotea packardii</i>	<i>Sphalloplana hubrichti</i>	<i>Physella sp.</i>	<i>Batrachus brachycaudus</i>
13 Oct 2007	9	10	11	1	1	1	1
26 Mar 2011	1	14	14	0	1	0	0
9 Aug 2014	0	24	66	0	0	0	0

crowding out native plants that would normally retain the soil. The picture in the cave was even grimmer. The stream habitat had been reduced to mud and leaves. The Illinois Cave Amphipod was gone, and only two species remained, an isopod and an amphipod which occur in caves as well as surface streams in the area.

Wednesday Cave had been purchased with the hope that it might serve as a refugium for the Illinois Cave Amphipod. Unlike Reverse Stream Cave, Wednesday Cave as a relatively small in-feeder of the Annbriar Groundwater Basin, was not susceptible to disturbances to the trunk stream of the groundwater system. It

was believed that if the main stream suffered a significant environmental insult, it could be repopulated by the ICA population in the relatively isolated Wednesday Cave, protected in a dedicated state nature preserve.

Unfortunately, the stewardship of the land was not up to the task, and the Illinois Cave Amphipod was extirpated by sedimentation of the critical gravel habitat. Now the cave is buried under the mud...a “million dollar mud-hole”... abandoned to one of the few things perhaps still interested in using the cave...Greenhouse Millipedes.

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